

## **REMARKS**

Applicant requests reconsideration of the rejections set forth in the Office Action dated November 4, 2008.

Claims 1-2, 6-12, 14, 16-33, and 38-41 are pending. Claims 1, 6-7, 14, 16-18, 23, 27, 32 and 38 have been amended. Claims 3-5, 13, 15 and 34-37 have been canceled. No new matter has been entered into the application by way of this Response.

### ***Claim Rejections Under 35 U.S.C. §101***

The Examiner rejected claims 1-41, alleging the claimed invention is directed to non-statutory subject matter. Specifically, the Examiner alleges that “the claimed subject matter amounts to a claim to a mathematical algorithm and further to a method of manipulating a mathematical construct, in this case a model used to simulate the flow of fluid through a porous media.” The Examiner further rejected claims 1-31, stating that all process claims must be “tied” to another statutory class or (2) transform underlying subject matter to a different state or thing. Applicant has amended claim 1 to recite a method of evaluating the transmission of a property within a subsurface geologic reservoir to locate and operate a well to produce subsurface hydrocarbons from the subsurface geologic reservoir. Amended claim 1 includes additional steps of: simulating the transmission of the property within the subsurface geologic reservoir, wherein simulating the transmission of the property within the subsurface geologic reservoir, wherein simulating the transmission of the property includes displaying at least one of said extremum paths, at least one vertex, or at least one edge on a graphical device; and locating and operating wells to produce subsurface hydrocarbons from the subsurface geologic reservoir based on the simulation of the transmission of the property. With these amendments, independent claim 1 includes recitations clearly within the category of statutory subject matter. Furthermore, independent claims 1 and 32 as amended are directed to statutory subject matter. Instead of merely manipulating abstract concepts or constructs (e.g., the claimed vertices) as asserted by the Examiner, the methods of amended claims 1 and 32 evaluate concepts that represent physical characteristics of a subsurface geologic reservoir, such as a fluid property. Furthermore, amended claims 1 and 32 include a step of displaying at least one of the extremum paths, at least one vertex, or at least one edge

on a graphical device. Therefore, amended claims 1 and 32 (and all claims depending therefrom) contain statutory subject matter. Lastly, independent claim 1 clearly is tied to another statutory class, i.e., locating and operating a well to produce subsurface hydrocarbons from a subsurface hydrocarbon reservoir. The Examiner is therefore requested to withdraw the rejections under 35 U.S.C. § 101.

### ***Claim Rejections Under 35 U.S.C. § 102***

The Examiner rejected claims 1, 2, 32 and 33 under 35 U.S.C. § 102(b) as allegedly being unpatentable over “Greed: Shortest Path” by Kevin Wayne (Wayne). Applicant respectfully traverses these rejections.

Applicant has amended independent claim 1 to include the subject matter of claims 3, 4, 5, 13 and 15. Amended claim 1 now recites that the cost is selected from a measure representative of resistance to fluid flow. The Examiner rejected claim 4, from whence this recitation was taken, citing page 4 of Wayne, which discusses various features of a shortest path network. The concept of “arc cost” is introduced as a portion of a cost of a given path. The term “arc cost” is not further defined. Nothing in Wayne teaches or suggests that the concept of “arc cost,” as mentioned by Wayne, could represent resistance to fluid flow. Therefore, claim 1 is allowable.

Claim 1 also recites that the cost is selected from a value calculated from transmissibility, phase potential difference and phase mobility. The Examiner rejected claim 5, from whence this recitation was taken, citing Figure 39 and col. 16 lines 16-53 of Farmer to demonstrate a discussion of transmissibility therein. The cited passage of Farmer does mention transmissibility between two cells in a grid, however there is no suggestion or teaching in Farmer that a reservoir attribute such as transmissibility, phase potential difference, or phase mobility may be used as a cost to be summed in a graph-theory single-source shortest-paths algorithm, as is now recited in claim 1. Furthermore, the discussion in Farmer appears to relate to adjacent cells (col. 16 lines 17-20), and not to an extremum path having a source vertex and at least two destination vertices. Claim 1 is allowable.

Claim 1 now additionally recites that the set of vertices includes reservoir vertices and well vertices. The Examiner rejected claim 15, from whence this recitation was taken, asserting

Figures 1-13d2 and col. 7 lines 7-18 of Farmer teach this concept. Column 7 lines 7-18, reproduced below, contains no reference whatsoever to reservoir vertices or well vertices:

FIGS 1 through 13d2 are drawings from the “Gunasekera specification” which discloses the “Petragrid” unstructured gridder software (disclosed in prior pending U.S. patent application Ser. No. 08/873,234 filed Jun. 11, 1997 and entitled “Method and Apparatus for generating more accurate earth formation grid cell property information for use by a simulator to display more accurate simulation results of the formation near a wellbore” to Dayal Gunasekera, already incorporated herein by reference), which drawings are provided here to set the background for the “structured” gridder software of the present invention;

Figures 1 and 13d2 show one or more cells used in a simulator model. In Figure 1, the wellbores 17 defined to intersect the center portion of a cell. Figure 13d2 also shows what appear to be wellbores (vertical lines) contacting centers of cells. In contrast, Applicant’s amended claim 1 recites that vertices include reservoir vertices and well vertices. The wellbores of Farmer are not defined as vertices in the model. Claim 1 is allowable.

Claims 2, 6-12, 14, and 16-31 are allowable because they depend, directly or indirectly, from allowable claim 1.

Independent claim 32 has been amended to include the subject matter of claims 34, 35, 36 and 37. Similarly to now allowable claim 1, claim 32 now recites that the cost is selected from a measure representative of resistance to fluid flow (taken from now cancelled claim 35, which is similar to cancelled claim 4 herein), or is selected from a value calculated from transmissibility, phase potential difference and phase mobility (taken from now cancelled claim 36, which is similar to cancelled claim 5 herein). The arguments in the immediately preceding paragraphs are incorporated by reference herein with respect to claim 1, which now includes the subject matter of claims 4 and 5. Independent claim 32 is allowable for the same reasons claim 1 is allowable. Claims 33 and 38-41 depend from claim 1 and are allowable for at least the same reasons claim 33 is allowable.

### ***Claim Rejections Under 35 U.S.C. § 103***

The Examiner rejected claims 3-31 and 34-41 under 35 U.S.C. § 103(a) as being unpatentable over Wayne in view of U.S. Patent No. 6,106,561 to Farmer. Applicant has

canceled claims 3-5, 13, 15, and 34-37 herewith, thereby rendering moot the rejections thereto. With respect to the remaining claims, Applicant respectfully traverses the rejections.

Claim 6 recites that the cost is the reciprocal of transmissibility. The Examiner cites Figure 39 and col. 16 lines 16-53 of Farmer to demonstrate a discussion of transmissibility therein. The cited passage of Farmer does mention transmissibility between two cells in a grid, however there is no teaching or suggestion that such a cost can be a reciprocal of transmissibility, as recited in Applicant's claim 6. Furthermore, the discussion in Farmer appears to relate to adjacent cells (col. 16 lines 17-20), and not to an extremum path having a source vertex and at least two destination vertices. Therefore, claim 6 is allowable.

Claim 7 as amended recites that the cost is the reciprocal of the product of transmissibility and phase mobility. The Examiner cites Figure 39 and col. 16 lines 16-53 of Farmer to demonstrate a discussion of transmissibility therein. As set forth with respect to claim 6, the cited passage does not explain how transmissibility (or a reciprocal of transmissibility) is used as a summed cost. Furthermore, the cited passage says nothing about using phase mobility, the reciprocal of phase mobility, or the reciprocal of the product of transmissibility and phase mobility as a cost. Claim 7 is allowable.

Applicant believes the definition for extremum path given by the Examiner on page 7 of the Office Action ("a subpath that is a shortest path") is incorrect. Applicant has defined the terms extremum and extremum path in paragraph [0040] of the Specification, where extremum is defined as "the maximum or minimum of some value or calculation..." and states that "the extremum path of a group of paths may be either a path that has the highest cost or a path that has the lowest cost."

Claim 16 as amended recites storing, for each vertex on said each extremum path, data representing the identity of the predecessor vertex or the predecessor edge on said extremum path. Claim 17 as amended recites storing, for each vertex on each said extremum path, data representing the cost of predecessor edges connecting the source vertex to said each vertex on said extremum path. The Examiner asserts page 6 of Wayne to teach these concepts. Page 6 of Wayne discusses the existence of a shortest path with reference to nodes *s* and *v*. There is no discussion of storing, for node *v*, data representing the identity of node *s*, or data representing the cost of any arcs connecting nodes *s* and *v*. Claims 16 and 17 are therefore allowable.

Claim 18 recites that said at least one source vertex includes a *plurality* of source vertices and further including iterating steps (d) and (e) for each of said plurality of source vertices to determine a plurality of collections of source vertex extrema paths for each said source vertex to a *plurality* of destination vertices (emphasis added). The Examiner asserts pages 6 and 7 of Wayne teach these concepts. As previously discussed, page 6 of Wayne shows the existence of a shortest path. Page 7 of Wayne discusses defined properties of a shortest path, namely the optimal substructure property and the triangle inequality. All examples on pages 6-7 of Wayne have a *single* source node and a *single* destination node. There is no teaching or suggestion in Wayne of any iterative process to determine a plurality of collections of source vertex extrema paths from each of a plurality of source vertices to a plurality of destination vertices, as recited in claim 18. Claim 18 is therefore allowable.

Claim 19 recites that the plurality of source vertices includes well vertices. The Examiner asserts that Farmer (col. 14 lines 30-67 and col. 25) teaches well vertices/cells in the context of a simulation of a well reservoir. Applicant cannot find reference to well vertices in the cited passage. In fact, Farmer does not disclose that vertices can be well vertices. As previously discussed herein, Farmer teaches that wells may be assigned to *cells*, not vertices, in a geologic model (see Figure 13d2 of Farmer). Farmer does not disclose, teach or suggest placing a well at a vertex of a cell model. Claim 19 is allowable.

Claim 21 recites determining the most extreme extremum path of a set of extrema paths. The Examiner asserts pages 5-7 of Wayne teach this concept. This portion of Wayne, which has been described previously, teaches various properties of a shortest path. Wayne does not discuss a set of extrema paths, and does not teach determining the most extreme extremum path of a set of such paths. Claim 21 is allowable.

Claim 24 recites associating with each destination vertex within said first destination vertex group a value representative of the amount of a fluid contained within each said destination vertex and summing the total amount of fluid contained in said first destination vertex group. The Examiner asserts pages 2 and 5-7 of Wayne teaches these limitations. Applicant can find no discussion or suggestion in Wayne to associate a value of the amount of a fluid at any source vertex or node. There is also no discussion or suggestion in Wayne to sum the total amount of fluid in a first destination vertex group. Claim 24 is allowable.

Claim 25 recites that the plurality of source vertices include vertices selected randomly and further including randomly selecting extrema paths from each of said randomly selected source vertices. The Examiner asserts pages 2 and 5-7 of Wayne teaches these limitations. These pages of Wayne disclose or suggest nothing regarding randomly selecting vertices or randomly selecting extrema paths from each of the randomly selected source vertices. Claim 25 is allowable.

Claim 26 recites that the plurality of collections of source vertex extrema paths contains at least two different extrema paths that have at least one common vertex and further comprising segregating the extrema paths from said plurality of collections of source vertex extrema paths into two or more groups, each of said groups comprising only paths that have no common vertices. Pages 2 and 5-7 of Wayne, which the Examiner cites against claim 26, do not disclose multiple extremum paths. The network of page 2 shows multiple arcs or paths in a network, but does not define an extremum path. Pages 5-7 discuss a shortest path network but do not disclose multiple extremum paths. Furthermore, Wayne does not teach or disclose segregating source vertex extrema paths into groups defined by having paths that have no common vertices. Claim 26 is allowable.

Claim 27 recites (f) sorting said plurality of source vertex extrema paths according to said paths' relative summed costs; and (g) creating a display of said plurality of source vertex extrema paths' sorted relative summed costs. The Examiner asserts page 8 of Wayne teaches these limitations. The pseudocode on page 8 of Wayne does not disclose sorting source vertex extrema paths according to their relative costs, and likewise does not disclose creating a display of the plurality of source vertex extrema paths' sorted relative summed costs. Claim 27 is allowable.

Claim 28 recites calculating the sample cumulative distribution function of path cost for said plurality of source vertex extrema paths and wherein said creating step (g) includes creating a display of said sample cumulative distribution function. Nothing in pages 1-8 of Wayne discloses calculating a cumulative distribution function of path cost for a plurality of source vertex extrema paths. As previously discussed, Wayne discloses basic principles of the shortest path concept. Wayne does not disclose or suggest creating a sample cumulative distribution function as recited in claim 28. Claim 28 is allowable.

Claims 29 & 30 recite that the single-source, shortest-path algorithm contains a priority queue implemented using a recursive formulation (claim 29) or an iterative formulation (claim 30). Applicant cannot find in Wayne any discussion or suggestion of a priority queue, a recursive formulation, or an iterative formulation. Claims 29-30 are allowable.

Claims 39-41 contain limitations similar to claims 15 (incorporated into claim 1), 27, and 29, respectively. Applicant incorporates by reference herein the arguments made with respect to claims 15 (in claim 1), 27 and 29. Claims 39-41 are allowable.

Applicant does not acquiesce in the Examiner's characterizations of the art. For brevity and to advance prosecution, however, Applicant may have not addressed all characterizations of the art and reserves the right to do so in further prosecution of this or a subsequent application. The absence of an explicit response by Applicant to any of the Examiner's positions does not constitute a concession of the Examiner's positions. The fact that Applicant's comments have focused on particular arguments does not constitute a concession that there are not other arguments for patentability of the claims. All of the dependent claims are patentable for at least the reasons given with respect to the claims on which they depend.

### **CONCLUSION**

Applicant has made a diligent effort to place the claims in condition for allowance. However, should there remain unresolved issues that may require adverse action, it is respectfully requested that the Examiner telephone the undersigned Attorney so that such issues may be resolved as expeditiously as possible. For these reasons, this application should now be considered to be in condition for allowance and such action is earnestly solicited.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 05-1328 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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